



Cognitive and Behavioral Sciences at the Office of Naval Research

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14. ABSTRACT With one of its six research departments focused on enhancing the performance of US Navy and Marine Corps personnel, the Office of Naval Research (ONR) has invested considerably in the cognitive and behavioral sciences. A significant portion of this investment has been in basic and applied research in human cognition, designed to understand the human operator's cognitive capabilities in order to better support individual and team decision making in complex environments. This research, most of which is carried out at universities, will ultimately inform the design of human-machine interfaces such as spatio-temporal situation displays, decision support systems, and collaboration tools. This presentation will discuss relevant ONR programs in the cognitive and behavioral sciences, as well as provide an overview of ONR Global and the tools available to support collaboration between Indian researchers and the US Naval Research Enterprise.								
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US Naval Research: A Brief History



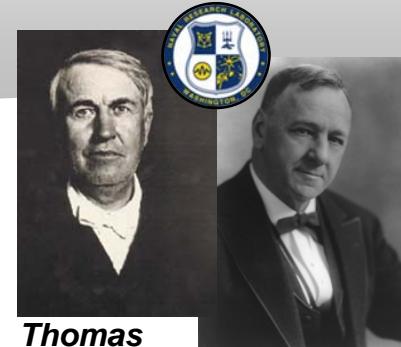
Naval Research Laboratory (1916)

- "[Conduct] exploratory and research work...necessary... for the benefit of Government service, including the construction, equipment, and operation of a laboratory...."



Vannevar
Bush

Harry S
Truman



Thomas
Edison

Josephus
Daniels

Office of Naval Research (1946)

- "... plan, foster, and encourage scientific research in recognition of its paramount importance..."

Nobel prize winner, Dr. William Philips, NIST

Laser cooling and trapping of atoms

Prof. Leon Chua, UC Berkeley

Memresistor

Prof. Anthony Brennan, University of Florida

Biomimetic technology that mimics shark's skin for antifouling

Nanosys, Palo Alto, CA

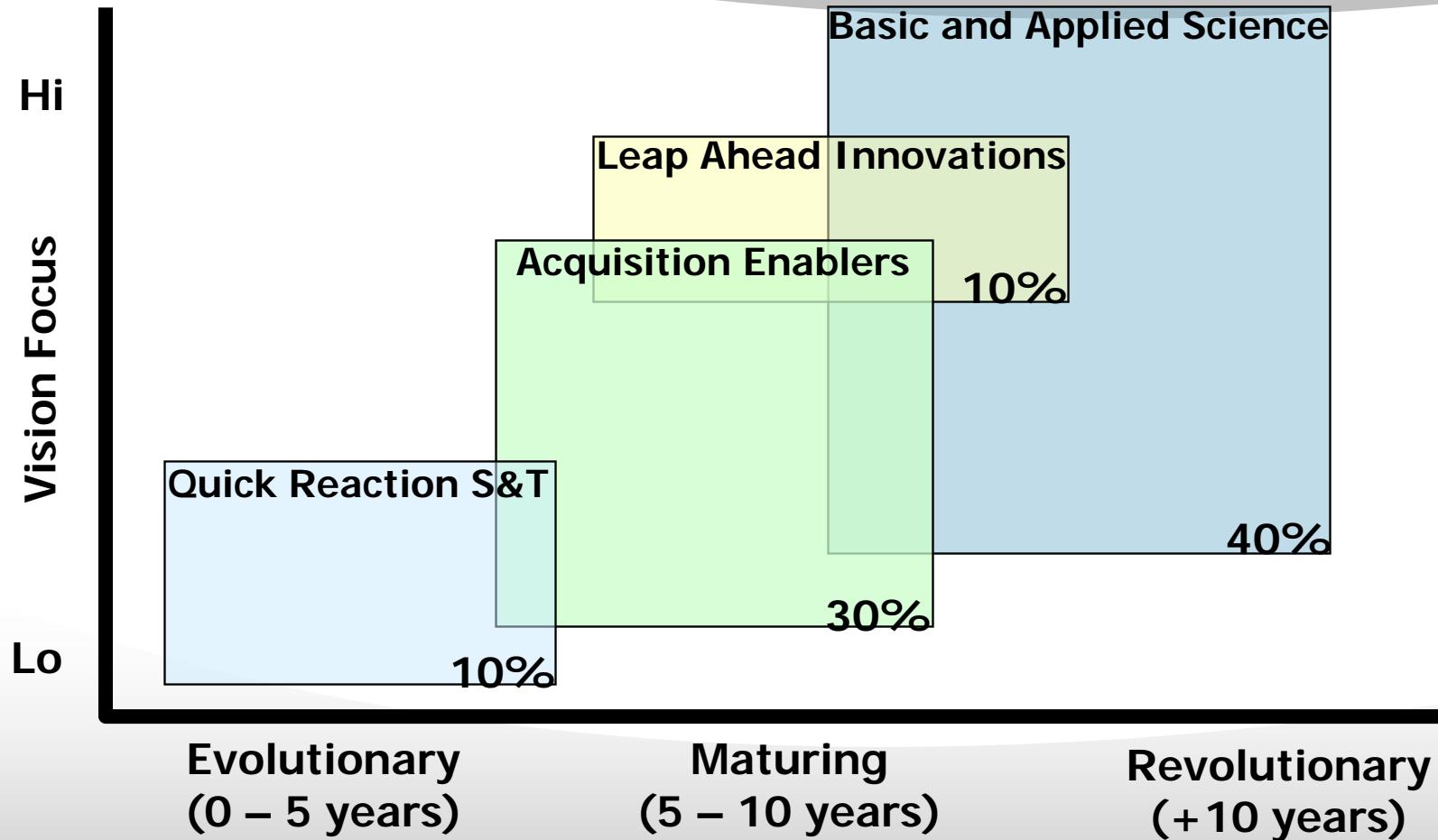
Bandage that stops bleeding 40% faster than conventional gauze

Quantum Health Innovations

Gryphon™ Infectious Disease Simulator that allows users to simulate a disease outbreak



ONR S&T Portfolio Balance



Human Performance & Protection



Bio-medical Science and Technology

- Battlefield combat death reduction ... Under investigation are blast, thermal, hemorrhagic shock, and traumatic brain injury
- Endemic, exotic and genetically modified pathogen protection
- Non-lethal weapons bio-effects - high power microwaves, underwater active denial systems, and directed energy
- Understand resilience to operational (fear, anxiety, ambiguity, and sleep deprivation) and environmental stressors
- Identify and exploit design principles evolved in Nature to enable new processes, sensors, or materials

Undersea Medicine

- Mechanisms of gas action in living tissue
- Hyperbaric oxygen toxicity and predictive/prophylactic methods
- Decompression sickness and arterial gas embolism
- Improve diver and submariner health and performance

Human Systems Science and Technology

- Social, cultural, and behavioral modeling to counter terrorism
- Creation of human behavior modeling techniques that reduce the cost of computational models of human behavior
- Develop more powerful integrative theories of human learning and instructional strategies
- Develop models of cognitive architecture to assist in managing attention in multimodal workstation
- Understand the cognitive processes underlying team collaboration and decision making

Information Analysis & Decision Support

Automated Image Understanding

- Fully automated segmentation and parsing of images
- Recognition of objects and their activities and inferring their intentions
- Tracking multiple objects under occlusion
- Fast/reliable algorithms with high detection rates & low false positives

Information Processing/Discovery/Integration/Presentation

- Methods and tools to manage data from multiple sensors and sources
- Exploiting non-traditional data types, such as free-form text, as sources of information in decision tools
- Tools to turn data into information that is relevant to the operator
- Decision-making methods and tools that optimize use of scarce and/or expensive resources

Computational Analysis ... Analytical and computational tools to apply to complex problems

- Meteorology and ocean dynamics
- Simulation of underwater explosions
- Simulation of micro-fluidics and nano-structures
- The inverse problems that arise from acoustic and electromagnetic wave propagation



Challenges in Cognitive Science for Naval Applications

- Training and Education S&T
 - Past & Current: Intelligent tutoring systems
 - Past & Current: Instructional strategies
 - Past & Current: Affordable behavior models for simulation-based training
 - *New: Synthetic teammates via high-fidelity computational cognitive models for team-based training*
- Human-Machine Interfaces
 - Past & Current: Cognitive models of warfighter decision-making for complex tasks (e.g. TADMUS)
 - *New: Richer cognitive models of warfighter decision-making in attentionally demanding multitasking situations (e.g. CIC watchstanding, UxV operation).*
- Intelligent Autonomy
 - Past & Current: UxVs almost entirely tele-operated
 - Past & Current: Human/UxV interaction via cumbersome, attentionally-demanding interfaces
 - *New: Toward Human-Level Competence for UxVs*
 - Robust natural language understanding grounded in cognitive architecture
 - Mechanisms in cognitive architectures to support both linguistic and non-linguistic social interaction – e.g. activity/intention recognition.
 - New inferential backbones for cognitive architectures supporting the integration of probabilistic, possibilistic and relational reasoning techniques.
 - Large-scale knowledge-bases/memories, extended operation in unconstrained/dynamic environments under conditions of both ignorance and uncertainty.



Infantry Immersion Trainer

- Purpose: Emphasize the Human Dimension of Warfare
 - Eliminate Steep Learning Curve In Combat
 - First Fire Fight No Worse Than Last Simulation
 - Inoculate Soldiers & Marines With Sights, Sounds, Smells, & Chaos of close quarters battle
 - Integrate essential skills:
 - Joint Operational Capabilities Tasks
 - Combat Hunter/Profiling
 - IED detection, disruption, and defeat
- Endstate:
 - Decision making focus, sensory overload, open-ended objectives
 - Individual and small unit self-confidence
 - Distributed, reconfigurable, multi scenario, combined arms
 - Ground based simulation on par with aviation simulation.



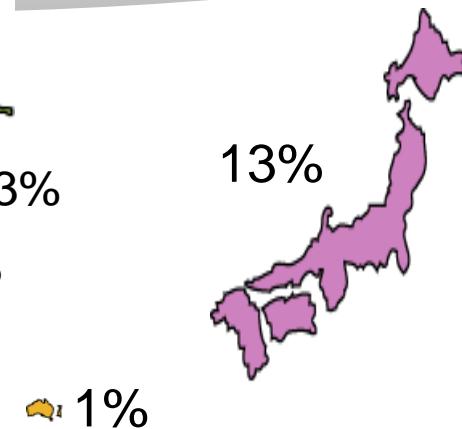
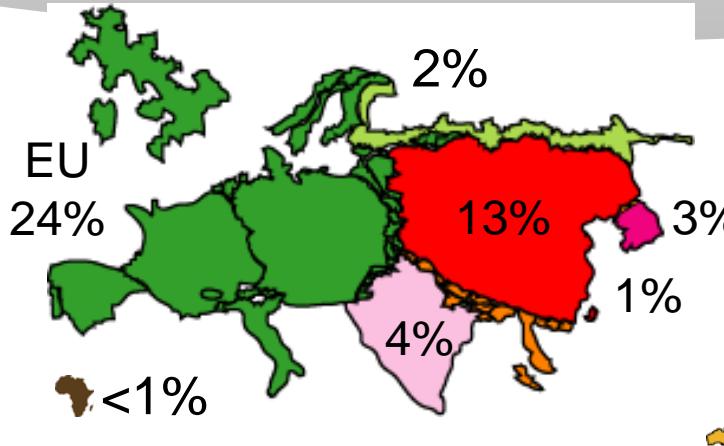
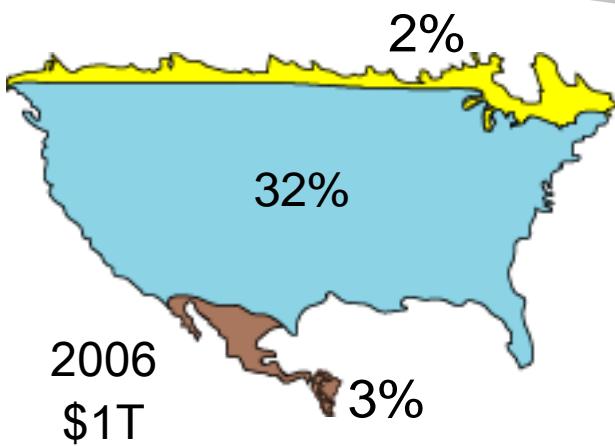
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World S+T Investment Dynamics

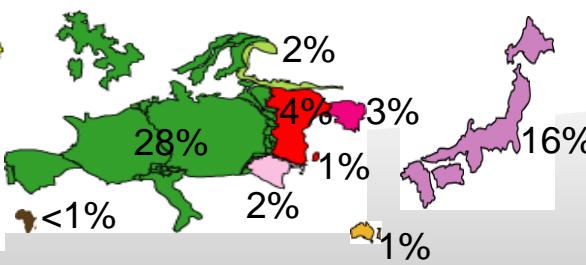
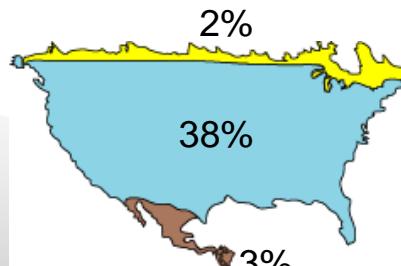
100% Global S&T Investment Growth in a Decade



** OECD 2007 PPP; 2007 Global R&D Report (Battelle)

+100%
Growth in Global
S+T Investment

1996
\$0.5T



* UIS S+T database; World Bank - PPP data



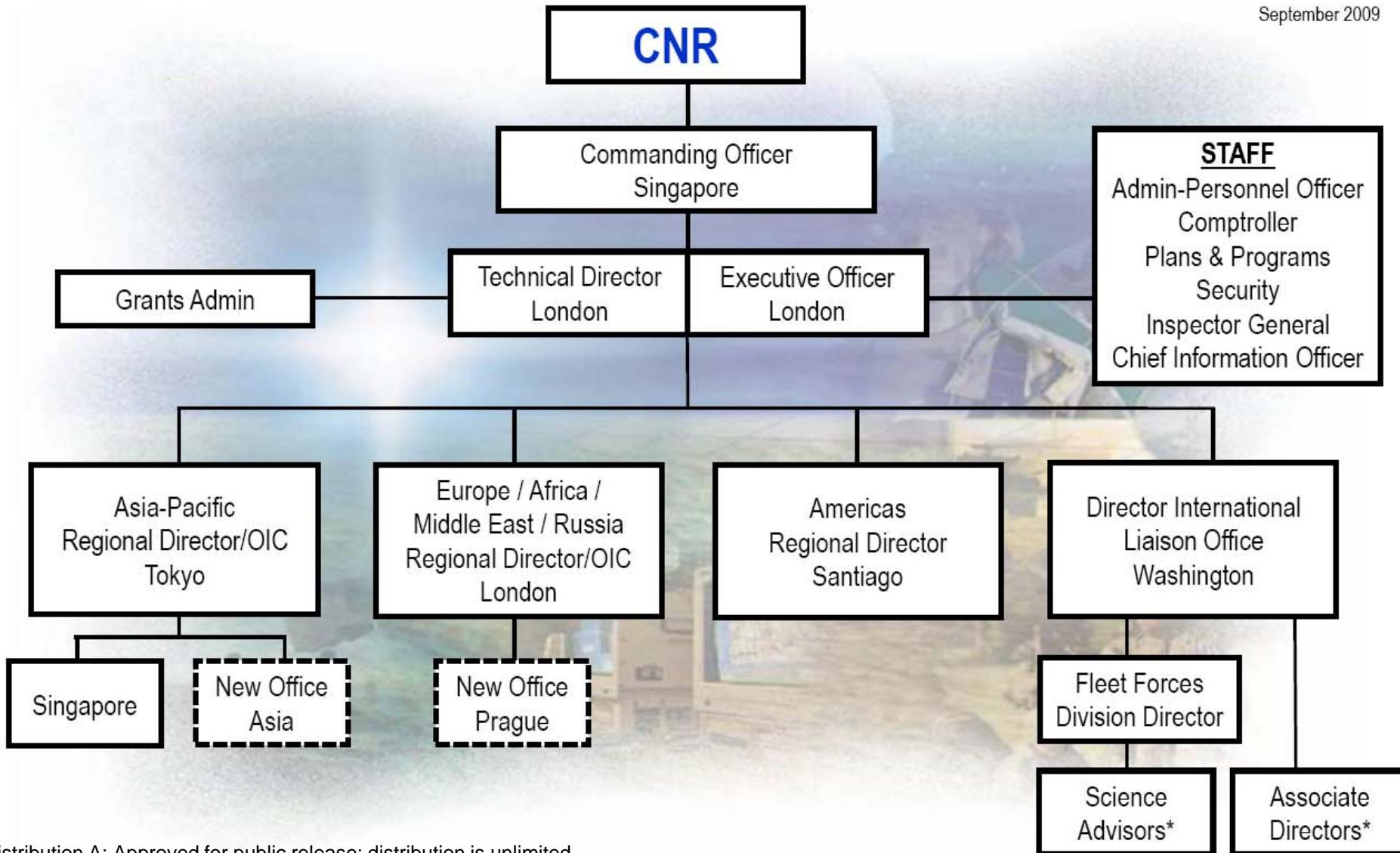
ONR Global Mission Statement

To search the globe for promising, emerging scientific research and advanced technologies to enable the Office of Naval Research to effectively address current needs of the Fleet and Force and to investigate and assess revolutionary, high-payoff technologies for future Naval missions and capabilities.



ONRG Organizational Chart

September 2009



ONR-Global Science Program Tools



Conference Support Program (CSP)

- Support foreign or international workshops and conferences of Naval interest

Liaison Visits

- ONRG technical staff visit international institutions to develop access and discover cutting edge S&T

Visiting Scientist Program (VSP)

- Support travel of foreign scientists to the US to socialize new S&T ideas or findings with the NRE

Naval International Cooperative Opportunities Programs (NICOP)

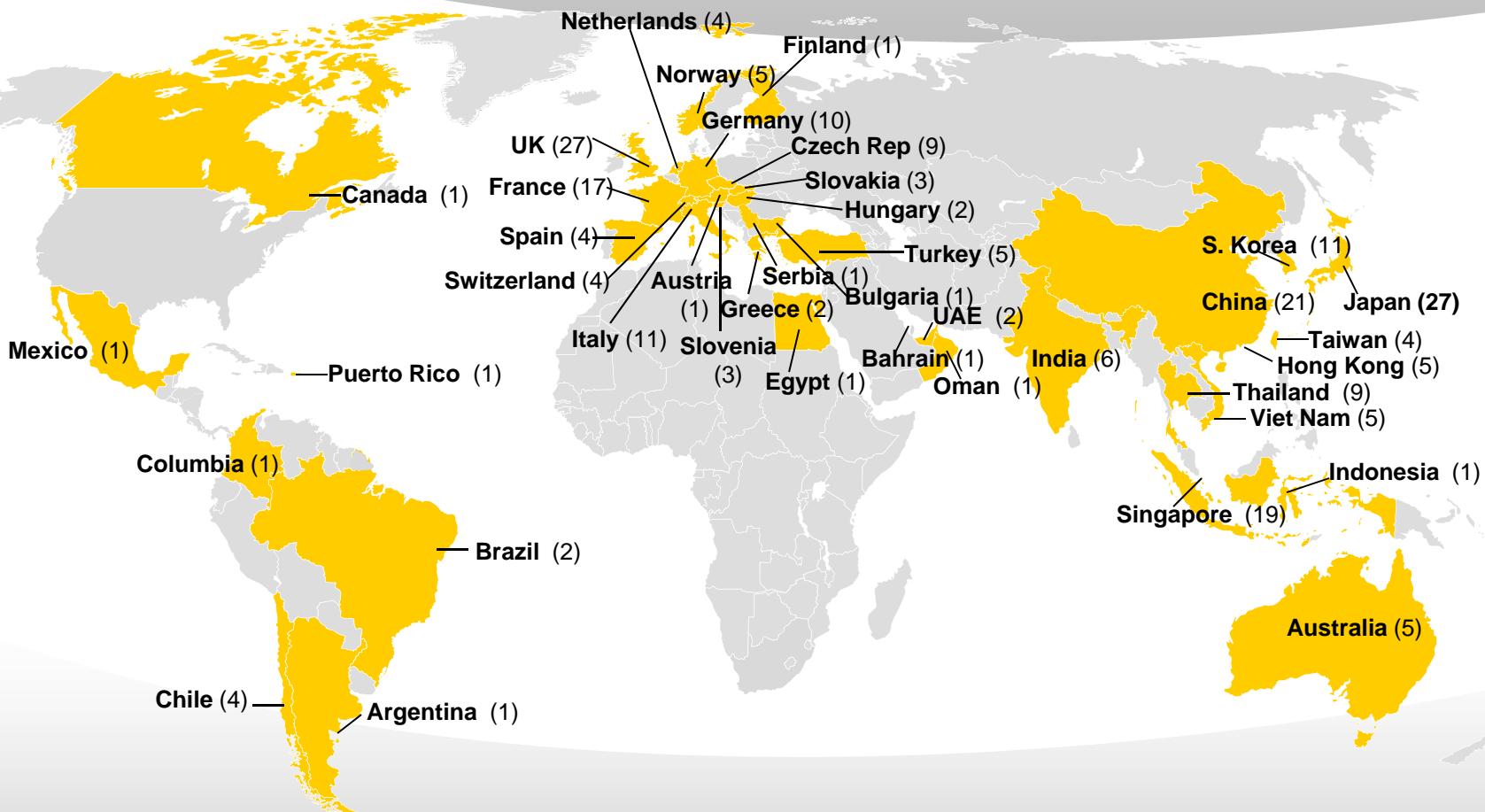
- Support the insertion of innovative, international S&T into core ONR and NRE Programs



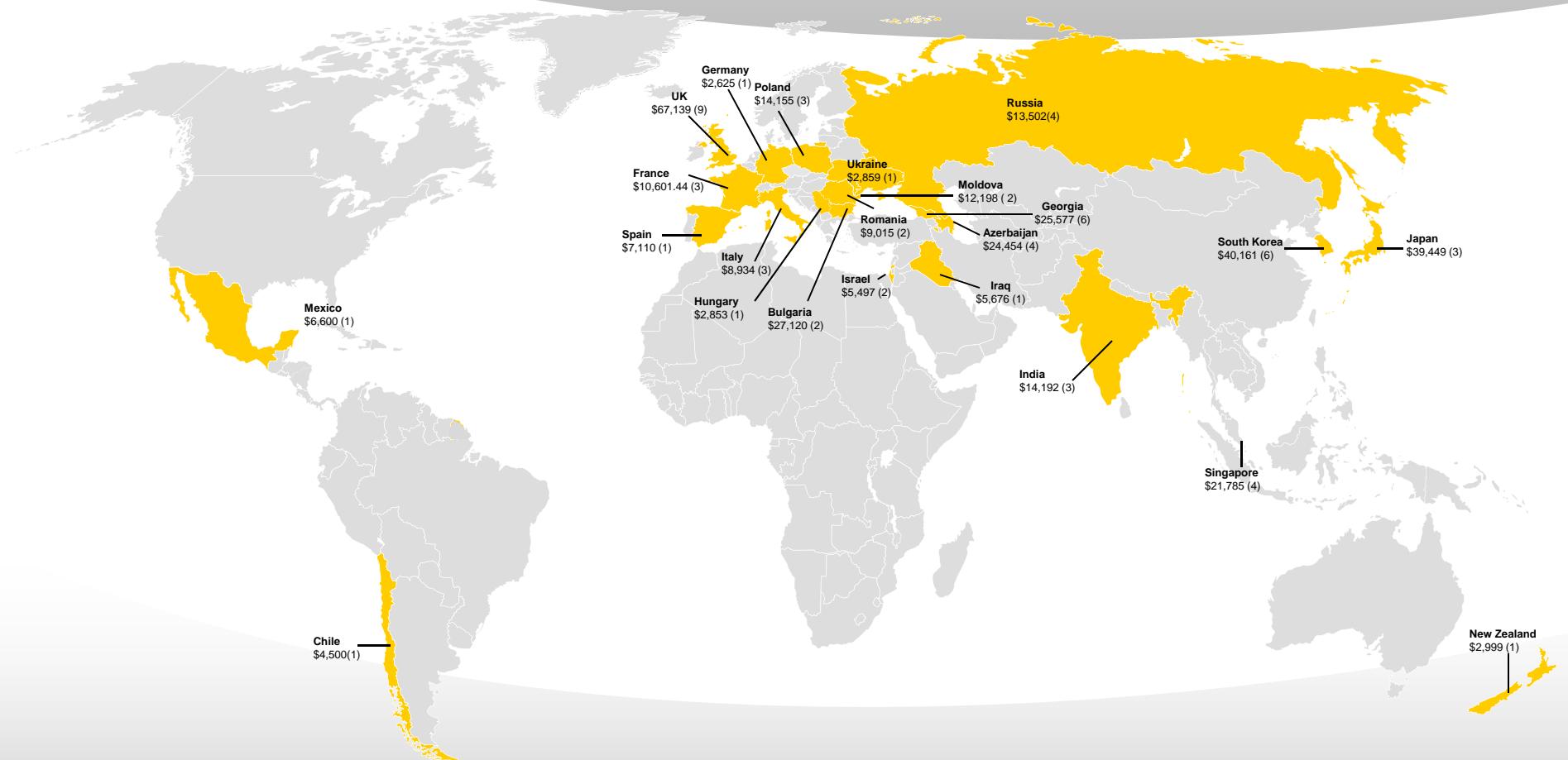
Small investments early lead to significant results



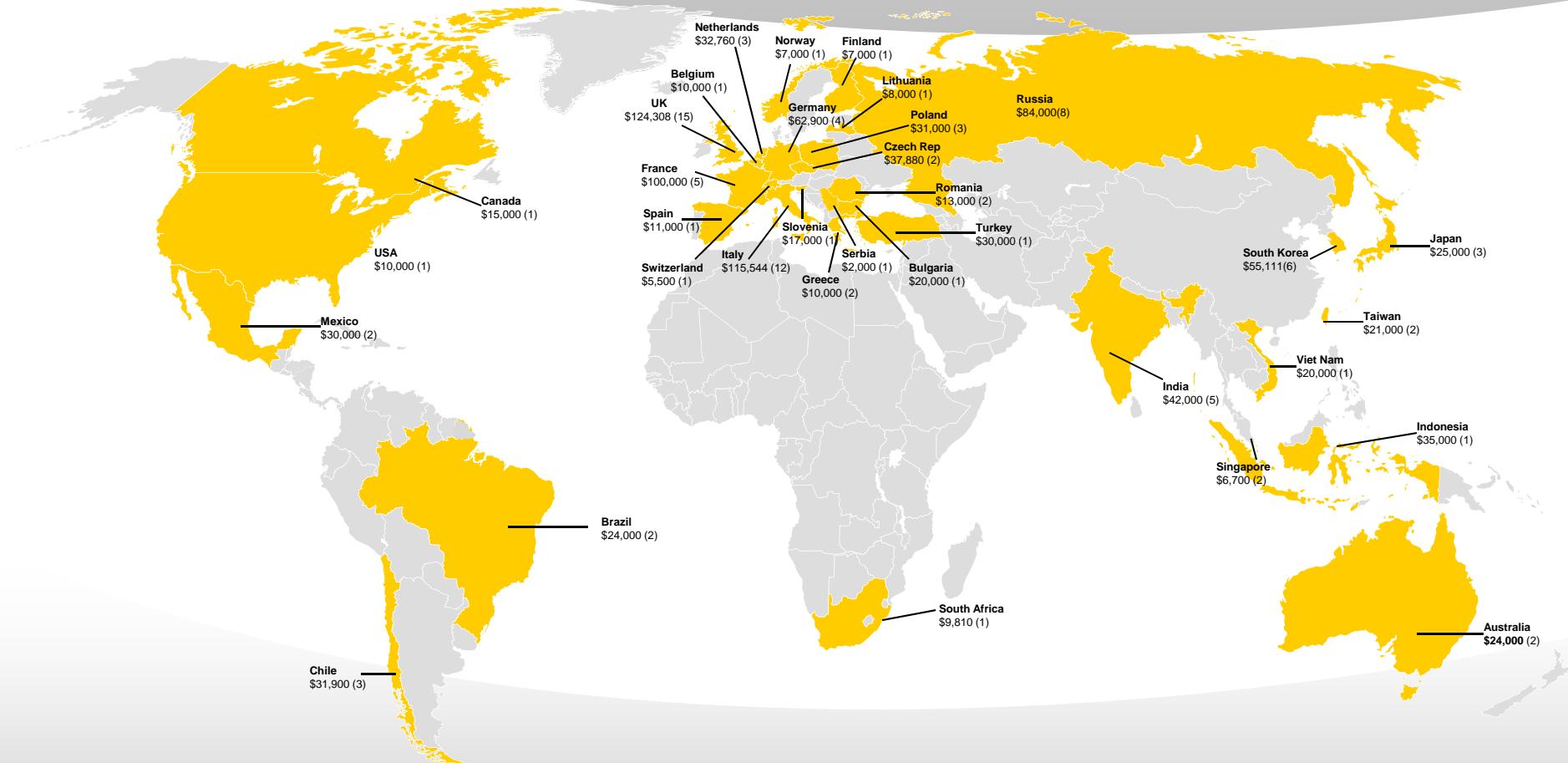
FY09 Liaison Visits



FY09 Visiting Scientist Program

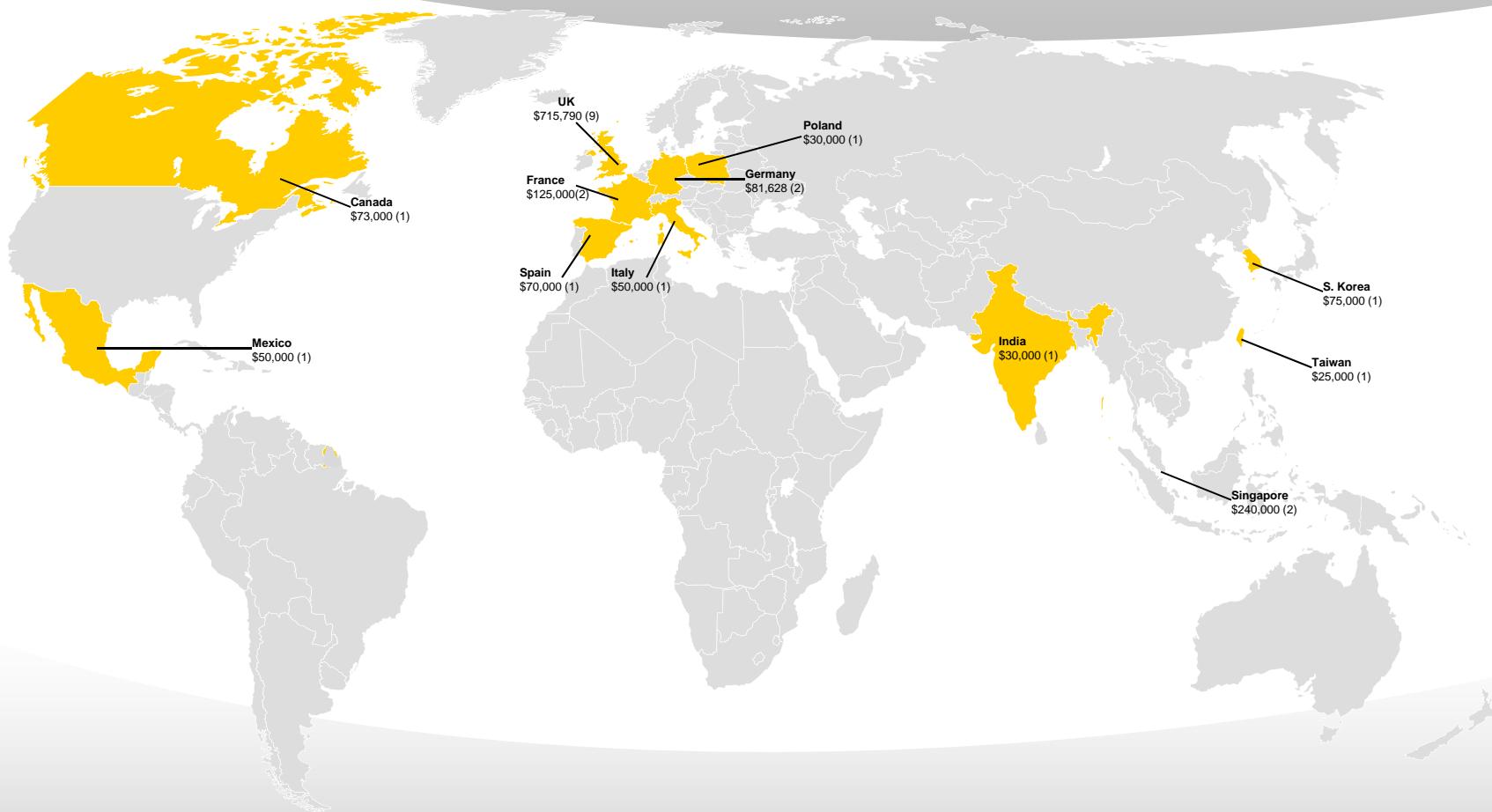


FY09 Conference Support Program





FY09 NICOP Grants





Conferences Supported in India

- IEEE Workshop on Spoken Language Technology (Goa, December 2008)
- Third Workshop on Intelligent Networks (Bangalore, January 2009)
- 3rd Indo-US S&T Roundtable (Bangalore, March 2009)
- 7th International Conference on the Beginnings of the Use of Metals and Alloys (Bangalore, September 2009)
- International Conference on Electroceramics (New Delhi, December 2009)
- XV International Workshop on the Physics of Semiconductor Devices (New Delhi, December 2009)
- International Workshop and Conference on Engineering and Marine Applications (Pune, January 2010)
- Indo-US Workshop on Shallow Water Acoustics (Goa, February 2010)
- 3rd US-Indo Frontiers of Engineering (New Delhi, March 2010)
- 14th Pacific-Asia Conference on Knowledge Discovery and Data Mining (Hyderabad, June 2010)
- 4th Indo-US S&T Roundtable (Bangalore, September 2010)
- International Conference on Fiber Optics and Photonics (Guwahati, December 2010)